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Relationship between sleep quality and the risk of metabolic syndrome in healthcare workers in hospitals

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ABSTRACT

Poor sleep quality has been shown to contribute to an increased risk of metabolic syndrome, especially in healthcare workers exposed to work stress and shift systems that do not match the circadian rhythm. This study aims to analyze the relationship between sleep quality and metabolic syndrome in health workers at the Medan City Hospital through a cross-sectional approach with 124 respondents. Sleep quality was measured using the Pittsburgh Sleep Quality Index (PSQI), while metabolic syndrome was evaluated based on International Diabetes Federation (IDF) criteria. The results showed that 61.3% of respondents had poor sleep quality, and 35.5% had metabolic syndrome. There was a significant association between poor sleep quality and metabolic syndrome (p=0.002), as well as a positive correlation between PSQI score and the number of components of metabolic syndrome (r=0.411; p<0.001). These findings suggest that sleep disorders play an important role in increasing metabolic risk in health workers, so promotive interventions on sleep quality need to be a priority in hospital occupational health policies.

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1. INTRODUCTION

Metabolic syndrome is a collection of medical conditions that include increased blood pressure, high blood sugar levels, excess fat around the waist, and abnormal cholesterol or triglyceride levels, which together increase the risk of heart disease, stroke, and type 2 diabetes (Alberti et al., 2009). Its prevalence continues to increase globally, along with unhealthy lifestyles and increased chronic stress in the work environment.

One of the important determinants that is increasingly being considered in the development of metabolic syndrome is sleep quality. Inadequate or disturbed sleep has been associated with impaired regulation of glucose metabolism, endothelial dysfunction, and increased insulin resistance (Spiegel et al., 2005). Sleep disorders are also known to cause the activation of the sympathetic nervous system and increased cortisol levels which have an impact on the overall body's metabolism (Tasali & Van Cauter, 2006).

Health workers, especially nurses and doctors who work in shift systems, are a particularly vulnerable group to sleep disorders. Irregular work schedules, repetitive night shifts, and high psychosocial stress cause circadian rhythm desynchronization which plays a role in a decrease in sleep quality (Ferri et al., 2016). This makes healthcare workers an important study group in relation to sleep and metabolic health.

Some studies show that shift work is closely related to an increased incidence of metabolic syndrome. Research by Esquirol et al. (2009) concluded that shift workers have a 1.5 to 2 times higher risk of metabolic syndrome than workers with a normal schedule. Sleep disorders are considered to be the primary mediators in the relationship, given their role in hormonal regulation and metabolism.

In the Indonesian context, there is little research that specifically links sleep quality to metabolic syndrome parameters in health workers. In fact, Indonesia's health sector experiences a high workload and is often faced with a shortage of manpower, especially in government hospitals. Understanding the risk factors for metabolic syndrome in this profession is crucial to support promotive and preventive efforts in the national health system.

This study is important to assess how much the sleep quality of health workers affects their risk of developing metabolic syndrome. With valid data, hospitals can design occupational health interventions, such as shift management, relaxation training, and routine health monitoring to prevent the development of metabolic syndromes that can reduce the productivity of health workers.

The main objective of this study was to analyze the relationship between sleep quality and metabolic syndrome parameters in hospital health workers. With a quantitative approach and validated instruments, it is hoped that the results of this study can contribute to occupational health policy and the development of evidence-based interventions that target improving sleep quality as a preventive measure against metabolic syndrome.

2. METHOD

2.1 Research Design

This study is an analytical quantitative study with a cross-sectional approach, aiming to determine the relationship between sleep quality and the risk of metabolic syndrome in health workers in hospitals. This approach allows data to be collected on independent variables (sleep quality) and bound variables (metabolic syndrome indicators) simultaneously at the same time, in order to obtain an efficient and fast picture of the relationship.

2.2 Research Location and Time

The research was conducted at the Regional General Hospital (RSUD) of Medan City, North Sumatra Province, during the period from February to April 2025. This hospital was chosen because it has an active shift work system and a high workload, which is relevant to examine the relationship between sleep disorders and metabolic health risks in medical personnel.

2.3 Population and Sample

2.3.1 Target and Affordable Population

The target population is all active health workers at the Medan City Hospital, including doctors, nurses, midwives, laboratory analysts, and other medical personnel. The affordable population is 180 healthcare workers who are qualified and willing to participate in the study.

Inclusion Criteria: Age 25–55 years; Minimum working period of 1 year; Actively involved in the shift work system (≥6 shifts per month); Not being on medication for sleep disorders or intensive metabolic therapy; Willing to sign informed consent.

Exclusion Criteria: Pregnant or breastfeeding; Have severe chronic diseases such as cancer or kidney failure; Taking sedatives, steroids, or hormone therapy in the past month**;** Not present at the physical/lab examination schedule.

2.3.2 Technique and Sample Quantity

Sampling was carried out by stratified random sampling based on profession to maintain proportionality of distribution. The number of samples is determined using the Slovin formula:

$$n = \frac{N}{1+Ne^2} \quad (1)$$

$$n = \frac{180}{1+180(0.05)^2} = 123.5 \rightarrow \text{rounded up to 124 respondents}$$

2.4 Research Variables

2.4.1 Independent Variables

Sleep quality, measured by the Pittsburgh Sleep Quality Index (PSQI) instrument. The total PSQI score ranged from 0–21, with a score of >5 indicating poor sleep quality.

2.4.2 Variable Dependency

The risk of Metabolic Syndrome, measured based on the International Diabetes Federation (IDF) criteria, is to have at least three of the following five components: Abdominal circumference: >90 cm (male) / >80 cm (female); Blood pressure ≥130/85 mmHg or moderate on antihypertensive medication; Fasting glucose level ≥100 mg/dL; Triglycerides ≥150 mg/dL; HDL cholesterol <40 mg/dL (men) or <50 mg/dL (women).

2.5 Research Instruments

The Indonesian version of the Pittsburgh Sleep Quality Index (PSQI) has been validated with a reliability of Cronbach's Alpha of 0.83. Clinical Observation Sheet, recording blood pressure, abdominal circumference, and laboratory results. Informed Consent Form and Participant Screening Sheet. Measuring device: Omron digital sphygmomanometer, WHO standard flexible measuring band, as well as blood test results from hospital laboratories (minimum 8-hour fasting).

2.6 Data Collection Procedure

2.6.1 Pre-survey

Instrument validation, enumerator training, and socialization to the hospital management.

2.6.2 PSQI Filling

Respondents fill out the questionnaire independently with the enumerator's guide

2.6.3 Physical measurements

Performed by trained nurses in the morning (08.00–10.00), including blood pressure and abdominal circumference

2.6.4 Laboratory test

Venous blood is taken after an 8–10 hour fast, to measure glucose, triglycerides, and HDL

2.6.5 Data validation and cleaning

Double data checks to detect entry errors or missing data

2.6.6 Feedback to respondents

The results of the examination were given to participants personally, as a form of ethics and health education

2.7 Data Analysis

Data processing and analysis is carried out with SPSS version 26.0, including:

2.7.1 Univariate analysis

Description of demographic characteristics, distribution of sleep quality, and parameters of metabolic syndrome

2.7.2 Bivariate Analysis:

Chi-Square **Test**: Assesses the relationship between sleep quality (good/poor) and metabolic syndrome status (yes/no); Spearman Rank Test: Tests the correlation between PSQI score and the number of metabolic syndrome components

2.7.3 Multivariate Analysis (optional)

If needed, logistic regression tests are used to determine the effect of sleep quality on metabolic syndrome with control for confounding variables (age, BMI, smoking status)

2.8 Validity and Reliability

The Indonesian version of PSQI used has been validated by the Faculty of Medicine, University of Indonesia, with a reliability test showing α = 0.83. Laboratory data collection is carried out at ISO 15189 Accredited Laboratories. Internal reliability test is performed on 10% of sample data as quality control.

3. RESULTS AND DISCUSSION

3.1 Characteristics of Respondents

A total of 124 respondents successfully participated in the entire series of studies. The characteristics of the respondents are described in Table 1 below:

Table 1. Demographic Characteristics of Respondents (n = 124)

Characteristics	Category	Frequency (n)	Percentage (%)
Gender	Man	42	33,9
	Woman	82	66,1
Age	25–34 years old	38	30,6
	35–44 years old	53	42,7

Characteristics	Category	Frequency (n)	Percentage (%)
	45–55 years old	33	26,6
Profession	Doctor	26	21,0
	Nurse	66	53,2
	Other medical personnel	32	25,8
Body Mass Index	Normal (18.5–24.9)	54	43,5
	Overweight (≥25)	70	56,5

3.2 Distribution of Sleep Quality and Metabolic Syndrome

Based on the results of filling out the Pittsburgh Sleep Quality Index (PSQI) and examining metabolic syndrome parameters, the following results were obtained:

Table 2. Distribution of Respondents' Sleep Quality

Categories Sleep Quality	PSQI Score	Frequency (n)	Percentage (%)
Good	≤ 5	48	38,7
Bad	> 5	76	61,3

Table 3. Distribution of Metabolic Syndrome Components

Components of Metabolic Syndrome	Positive Count (n)	Percentage (%)
Excess abdominal circumference	79	63,7
Blood pressure ≥130/85 mmHg	68	54,8
Fasting glucose ≥100 mg/dL	52	41,9
Triglycerides ≥150 mg/dL	46	37,1
HDL <40 mg/dL (L) / <50 mg/dL (P)	58	46,8
Meet ≥3 criteria (MetS)	44	35,5

3.3 Analysis of the Relationship between Sleep Quality and Metabolic Syndrome

Table 4. The Relationship of Sleep Quality with the Incidence of Metabolic Syndrome (Chi-Square Test)

Sleep Quality	Metabolic Syndrome (Yes)	No	Total	p-value
Good	8	40	48	
Bad	36	40	76	0,002

Note: There was a statistically significant association between poor sleep quality and the incidence of metabolic syndrome ($p < 0.05$).

Table 5. Correlation between PSQI Score and Number of Metabolic Syndrome Components (Spearman Test)

Variabel 1	Variabel 2	Coeficin (r)	p-value
Total PSQI Score	Number of MetS Components	0,411	0,000

Note: There was a moderate and significant positive correlation between an increase in PSQI (poor sleep quality) scores and the number of components of metabolic syndrome.

3.4 Validity and Reliability Analysis

Table 6. PSQI Validity Test Results (Item-Total Correlations, n = 124)

Komponen PSQI	r Count	r Table (α=0.05)	Information
Subjective sleep quality	0.624	0.177	Valid
Sleep latency	0.589	0.177	Valid
Sleep duration	0.617	0.177	Valid
Sleep efficiency	0.533	0.177	Valid
Sleep disorders	0.502	0.177	Valid
Sleeping pill use	0.468	0.177	Valid
Daytime dysfunction	0.487	0.177	Valid

Table 7. PSQI (Cronbach's Alpha) Reliability Test Results

Instruments	Number of Items	Cronbach's Alpha	Category
PSQI	7	0.835	Reliabel

3.5 Poor Sleep Quality is More Dominant in Health Workers

The results showed that 61.3% of respondents had poor sleep quality based on a PSQI score of > 5. This indicates that the majority of health workers at the Medan City Hospital experience sleep disorders. The high prevalence of poor sleep quality is very likely due to the shift work system, work stress, high responsibility, and emotional stress in the hospital environment.

This phenomenon is supported by research by Ferri et al. (2016) which found that health workers who work in the night shift system tend to have significantly lower sleep quality than those who work regular hours. Work shifts that do not match the circadian rhythm cause disruptions in the secretion of melatonin, which is important in regulating natural sleep patterns.

In addition, workload stress and psychological stress are the dominant factors that worsen sleep quality. In a study by Booker et al. (2018), it was found that nurses who experienced emotional fatigue had higher PSQI scores and were prone to insomnia. The hospital's stressful work environment, such as demands for fast service and high medical risks, also contribute to long-term sleep disorders.

This study corroborates previous findings that poor sleep quality is a systemic problem among medical personnel. In the long term, this condition not only decreases work performance but also has an impact on the metabolic and mental health of workers. Therefore, interventions to improve shift management and psychological well-being programs are becoming very urgent.

It is important to note that the proportion of female health workers in this study was larger (66.1%), which was also related to the risk of sleep disorders. Research by Zhang et al. (2020) shows that women have a higher susceptibility to sleep disorders due to hormonal fluctuations, the double burden of work and family, and a more intense emotional response to work stress.

3.6 High Prevalence of Metabolic Syndrome Components

The results showed that the components of metabolic syndrome such as excess abdominal circumference (63.7%), high blood pressure (54.8%), and high fasting glucose (41.9%) were quite dominant among the respondents. This shows that metabolic disorders are starting to become a serious issue even among health workers who ideally should have a better health status.

High abdominal circumference as an indicator of central obesity is a major problem. This is in line with a study from Kivimäki et al. (2015) that showed that abdominal obesity is the most powerful predictor of insulin resistance and metabolic syndrome. Central obesity is also related to a lack of physical activity, consumption of high-calorie foods, and short sleep time.

The condition of hypertension (≥130/85 mmHg) in 54.8% of respondents was also very worrying. This shows that high work pressure can contribute to the chronic activation of the sympathetic nervous system, which ultimately leads to increased blood pressure. This view is reinforced by a study from Choi et al. (2018) that found that shift work and sleep disorders cause circadian rhythm fluctuations in blood pressure.

High fasting glucose levels in 41.9% of respondents indicated that metabolic disorders had already reached glucose tolerance disorders, which is prediabetes. According to Knutson et al. (2007), sleep disorders have an impact on glucose regulation through decreased insulin sensitivity and increased stress hormones such as cortisol. Thus, physiologically poor sleep quality can trigger metabolic dysfunction.

The high prevalence of ≥3 components of metabolic syndrome (35.5%) indicates that one-third of the health workers studied qualify for metabolic syndrome. This is in accordance with WHO global data that the shift work population shows a prevalence of metabolic syndrome between 30–45% (Esquirol et al., 2009). Thus, medical personnel face not only external risks (disease exposure), but also internal (their own metabolic health).

3.7 Significant Relationship Between Sleep Quality and Metabolic Syndrome

The chi-square test yielded a value of $p = 0.002$, indicating that there was a significant association between sleep quality and metabolic syndrome status. Respondents with poor sleep quality had a much higher prevalence of metabolic syndrome compared to those who had good sleep. These findings support the theory that sleep disorders play an important role in systemic metabolic dysfunction.

Research by Gangwisch et al. (2007) showed that individuals with a sleep duration of <6 hours per night had a double the risk of developing hypertension and metabolic disorders. Lack of sleep leads to a disruption of the balance between the hormones leptin and ghrelin, which triggers excessive appetite and insulin resistance.

This relationship is also confirmed by Shan et al. (2019), who state that poor sleep quality affects glucose and lipid regulation through the HPA (hypothalamic-pituitary-adrenal) axis. Chronic sleep disorders cause an increase in plasma cortisol that progressively worsens metabolic parameters.

This study also confirms that sleep quality measurement with the PSQI instrument can be used as an early indicator in detecting metabolic risk in high-risk populations. Sleep management-based interventions such as sleep hygiene, flexible work schedules, and early detection are important in suppressing the development of metabolic syndrome.

From these results, it can be concluded that improving sleep quality has great potential in the primary prevention of metabolic syndrome. The implementation of occupational health programs in hospitals needs to consider aspects of workers' fitness and sleep as a sustainable promotive and preventive effort.

3.8 Positive Correlation between PSQI Score and Number of Metabolic Syndrome Components

From the Spearman correlation test, a coefficient of $r = 0.411$ ($p < 0.001$) was obtained, which means that there was a moderate positive correlation between the PSQI score and the number of metabolic syndrome components. This means that the worse the quality of sleep (the higher the PSQI score), the more metabolic syndrome components a person has.

These findings support the study of Taheri et al. (2004) who reported that short sleep duration is associated with increased BMI, blood pressure, as well as impaired lipid and glucose metabolism. This correlation explains that sleep disorders are not only single-impacted, but worsen metabolic conditions cumulatively.

Poor sleep quality, including in terms of sleep latency, sleep efficiency, and daytime dysfunction, has been shown to be associated with major components of MetS. This is in line with the findings of Itani et al. (2017), who stated that decreased sleep efficiency leads to increased triglyceride levels and blood pressure in the morning due to nighttime autonomic stress.

The PSQI score as a multifactorial total score is able to capture the complexity of the sleep disorders experienced by respondents. In other words, it's not just sleep duration that matters, but also subjective quality, frequency of awakening, and the effects of daytime dysfunction that affect each other in the metabolic system.

From these results, it can be suggested that hospitals and health institutions should start using PSQI measurements on a regular basis as an occupational health screening tool to detect workers who are at high risk of metabolic disorders due to poor sleep.

3.9 Excellent Validity and Reliability of PSQI Instruments

The validity test showed that all PSQI items had a significant item-total correlation (r count > r table = 0.177), while the total reliability of the instrument obtained Cronbach's Alpha = 0.835, indicating that PSQI is a very reliable measurement tool for the health worker population in Indonesia.

This validity supports the study of Buysse et al. (1989), the original developers of PSQI, who found high construct validity in a wide range of populations. The Indonesian version adaptation used was also previously tested by Setyowati et al. (2012) with valid and reliable results for clinical and research use.

An alpha reliability value of > 0.8 indicates high internal consistency, which means that all components of PSQI are correlated in measuring the concept of sleep quality. This is important to ensure that the measurement results reflect the real conditions of the respondents.

These results show that PSQI can be a reliable measuring tool for occupational health monitoring purposes. The use of PSQI in a hospital setting allows for rapid, practical, and non-invasive screening to identify broader metabolic risks.

PSQI can also be combined with simple supporting examinations such as abdominal circumference and blood pressure measurements to establish a community-based early detection system in the medical work environment.

4. CONCLUSION

Poor sleep quality has been shown to have a significant association with an increased risk of metabolic syndrome in healthcare workers in hospitals. Sleep disorders consistently contribute to the deterioration of metabolic health parameters such as blood pressure, glucose, and abdominal circumference, indicating the importance of attention to non-physical aspects in maintaining the

health of medical personnel. The positive relationship between the PSQI score and the number of metabolic syndrome components underscores that sleep is not just a biological need, but also a crucial component in the body's systemic balance, especially in demanding work environments such as hospitals. Health service institutions need to develop a more holistic occupational health policy, by including monitoring and improving sleep quality as part of promotive and preventive programs for health workers, through sleep hygiene education, shift system improvement, and routine screening using valid measuring tools such as PSQI.

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